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CEERI Develops Vapour Degreaser and Photo-resist Spinner

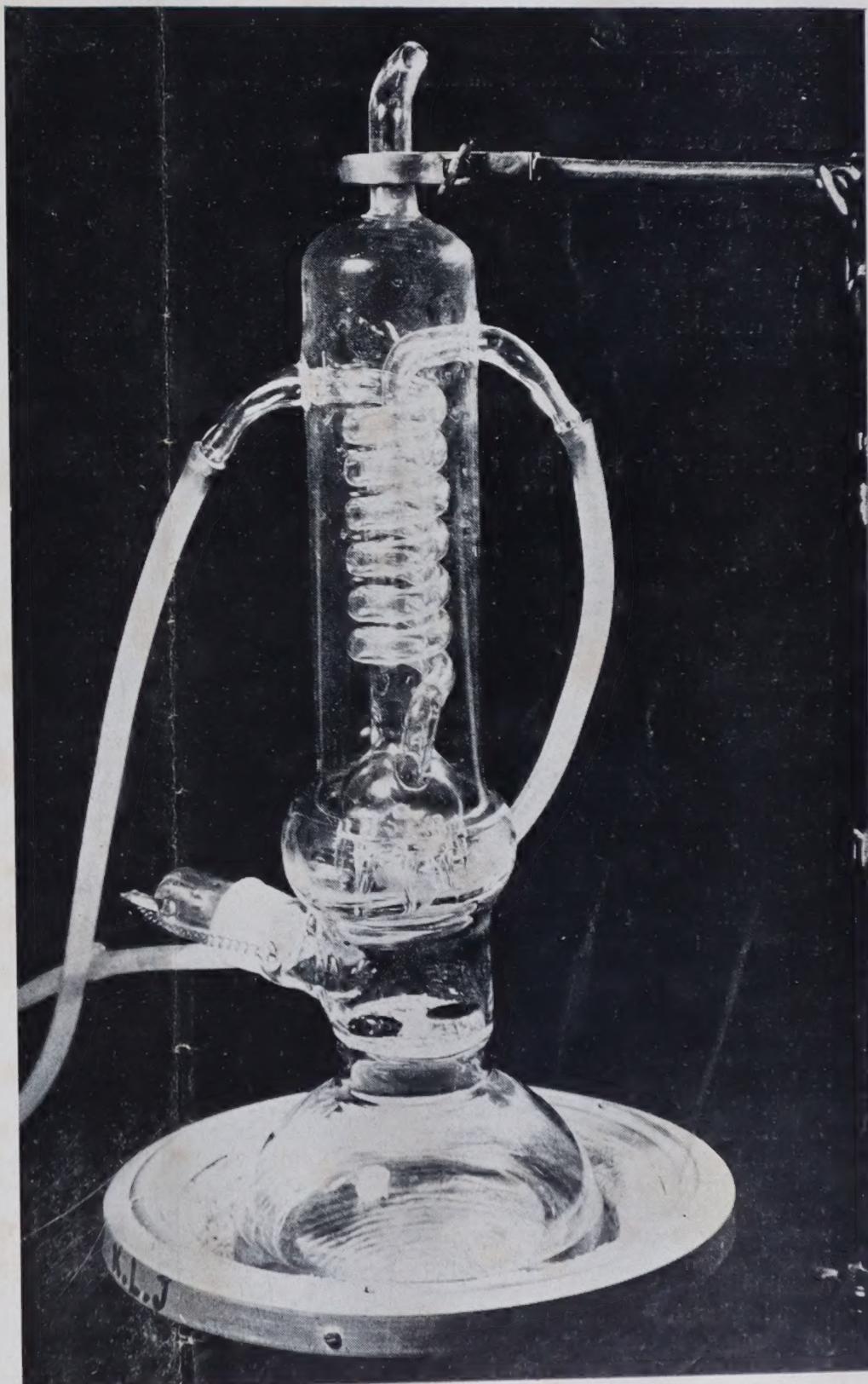
The Central Electronics Engineering Research Institute (CEERI), Pilani has been active in the development of planar technology for semiconductor devices, such as silicon transistors, diodes and integrated circuits. During the course of this work, a number of machines and instruments have been designed and fabricated. Recent among these are a vapour degreaser and a photo-resist spinner.

Vapour degreaser

An all-glass vapour degreaser has been developed for high-level cleaning of transistor and microcircuit substrates by vapours of solutions like trichlorethylene, xylene, alcohol, photo-resist strippers, etc. A salient feature of the degreaser is that the job is cleaned not only by the incoming vapours, but by the condensed hot solvent dripping from the bottom part of the condenser. Thus the degree of cleanliness increases with the length of time for which the job is placed in the degreaser. In a conventional degreaser, however, the job gets cleaned only by vapours condensed over the job. The loading and unloading of a job in the degreaser is done through a side window, with the result that the likelihood of contamination is less than if the loading is done from the top as in a conventional degreaser. In addition, the tweezers or the tong used to pick up the cleaned job is automatically cleaned by vapours before it comes in physical contact with the job.

Photo-resist spinner

An important step in the fabrication of semiconductor devices is the application of a thin, uniform and



Vapour degreaser developed by CEERI, Pilani

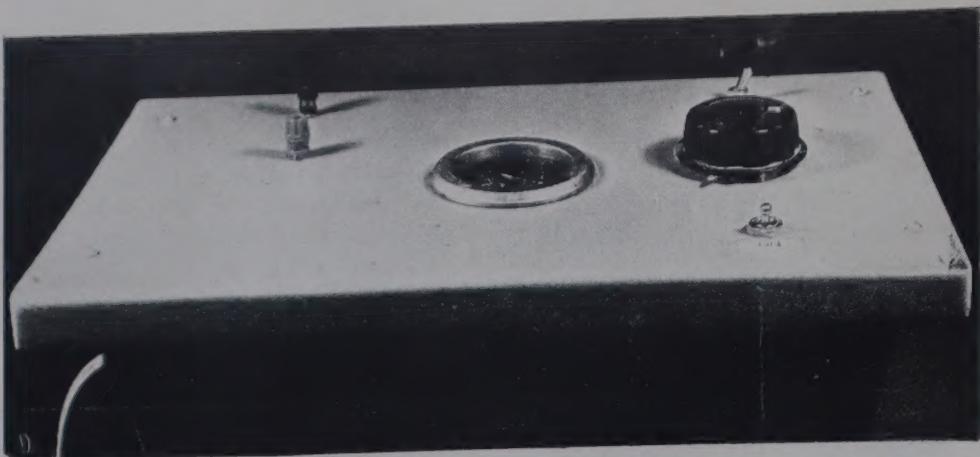


Photo-resist spinner developed by CEERI, Pilani

adherent coating of a photo-resist material on a silicon wafer. For this purpose a machine, photo-resist spinner, has been developed, whereby the wafer, on which a few drops of photo-resist material are placed, is rotated at high speed with the result that the photo-resist material is spread uniformly on the wafer.

The wafer is held in position by vacuum. The salient features of the machine are high acceleration, the acceleration time being less than one second; and variable speed ranging from 100 to 15 000 rpm. Two models have been developed, one for coating one slice and the other for three slices at a time.

Substrate Induction of Liver Glutaminase in Normal and Tumour-bearing Rats

Investigations carried out by Dr G. C. Shrivastava of the Indian Institute of Experimental Medicine (IIEM), Calcutta had shown that normal cells growing in tissue culture in the presence of glutamine show an increased glutaminase activity which is inhibited in the presence of actinomycin-D. This work was extended to *in vivo* systems by Dr Shrivastava at Dr W. E. Knox's laboratories, Cancer Research Institute, New England Deaconess Hospital, Boston where he worked from Jan. 1969 to Jan. 1970 on study leave from IIEM.

Normal animals when injected with glutamine were found to show an elevation of the glutaminase levels in liver but not in kidney. The level of this enzyme in liver was nearly doubled within 4 hr of the injection. This increase in glutaminase could be inhibited by injecting either actinomycin-D or puromycin to the animals, showing thereby that there was a *de novo* synthesis of the enzyme in the presence of the substrate. This inhibition in the synthesis resulted in a further increase in the plasma level of glutamine. It was then decided to see if the enzyme induc-

tion was mainly due to the presence of glutamine or to the stress created by the injection, thereby releasing hormones which in turn might be responsible for the induction of this enzyme. Livers were taken out of the animals and perfused with a mixture of amino acids. It was observed that in the absence of glutamine there was no increase in the glutaminase activity, but when glutamine was added to the perfusate the enzyme concentration nearly doubled within 2 hr of the perfusion. Further experiments were carried out in the presence of the protein synthesis inhibitors like puromycin and actinomycin-D. These inhibited the induction of the glutaminase in isolated livers, clearly indicating thereby that the increase in the level of glutaminase in liver was a pure substrate induction. This seems to be the first time that a pure substrate induction of an enzyme has been seen in a mammalian system.

In the case of tumour-bearing animals, however, the injection of glutamine increased the glutaminase level in liver by about 30% but there was no change in the tumour

glutaminase level. This may be due to the fact that the tumour has the kidney type glutaminase, which is insensitive to the presence of glutamine. This further proves that the glutaminases in liver and kidney are of two different types.

Documentation & Reprography Training

The Government of India have accorded recognition to the training course in documentation and reprography conducted by Insdoc, New Delhi as equivalent to a post-graduate qualification in documentation and reprography. An official memorandum dated 5 Feb. 1970 issued by the Ministry of Education & Youth Services reads as follows : "The Government of India, after carefully considering the contents, duration and standard of the course of study conducted by the Indian National Scientific Documentation Centre, Council of Scientific & Industrial Research, New Delhi have decided to recognize the training course in documentation and reprography of the Insdoc as equivalent to a postgraduate qualification in documentation and reprography, for purposes of employment under the Central Government".

The 12-month training course was started at Insdoc in August 1964. In view of the intensive nature of the course only a small number of candidates are admitted every year. During the course, the students get practical training in all aspects of documentation including computer methods of information handling and reprography. The students are also given an opportunity to work in the various sections of Insdoc as a part of practical training. An important requirement of the course is the preparation of a project report by every student. Many of these reports are in special fields and some of them are being published.

Sixty-four candidates who have undergone this course so far were drawn from national laboratories, the Bhabha Atomic Research Centre, the Defence Research and Development Organization, universities, institutes of technology and public sector undertakings. Most of them are now manning important library and documentation units in the country.

Seminar on Electrochemistry

Holding of seminars on Electrochemistry has been an annual feature with the Central Electrochemical Research Institute (CECRI), Karaikudi. The tenth in the series, held from 25 to 28 Nov. 1969, was inaugurated by Shri M. V. Arunachalam, Chairman of the institute's executive council.

Fifty-two delegates including three foreign scientists participated in the seminar in which 108 papers were contributed and discussed in seven technical sessions.

The first session was on *Electro-deposition and metal finishing* in which 13 papers were presented.

Seven papers were read in the second session on *Batteries*, out of which six were from the institute. The nature of copper that could be produced as the end product of copper oxide cathode primary wet cells was discussed at length. It could be pyrophoric and could be easily converted into cupric oxide for use again by simple exposure to air depending upon the particle size of the cupric oxide employed initially, the type of binder used, the method of construction of the copper oxide cell and the nature of the discharge to which the alkaline copper oxide cell is subjected.

Electro-organic and electro-inorganic products was the subject matter of the third session wherein 14 out of 15 papers read and discussed were from the institute. During discussions on the electrochemical oxidation of anthracene to anthraquinone it was concluded that wherever the demand exists for green chromium oxide (for use as a pigment) and Glauber's salt, chemical method could be competitive to the electrochemical method. It was pointed out that the use of an integrated chlorine dioxide producing unit utilizing byproduct hydrochloric acid for decomposing sodium chlorate-sodium chloride mixtures as obtained from an electrolytic cell could be economical. The conversion of chlorine dioxide to a mixture of potassium chlorate and sodium chlorite and their easy separation could also be economical under certain conditions.

Electrothermics and electrometallurgy was the title of the next session.

The institute contributed seven out of a total of 12 papers. In the paper 'Electrochemical phosphorus as a route to phosphatic fertilizers' by C. M. Shah and coworkers from the Bhabha Atomic Research Centre, Bombay, it was pointed out that modern routes to electrothermal phosphorus should be considered such as those involving plasma arc and electrothermal fluidized bed, and also fluidized bed reduction of rock phosphate with carbon monoxide at high temperature, the carbon monoxide being derived from any fossil fuel by reaction with a mixture of byproduct carbon dioxide and byproduct oxygen. This session included a paper by V. V. Stender and coworkers from the Institute of Chemical Technology, Ukraine (USSR) on the processes of electrolytic deposition of manganese on solid and liquid cathodes. Discussion took place on the production of titanium dioxide concentrates from ilmenite. It was pointed out that the simple procedures developed by CECRI utilize low grade ilmenite, low grade manganese ore and byproduct hydrochloric acid to produce 75% titanium dioxide concentrates and pure manganese chlo-

ride solutions. Eighteen papers were read in the session on *Electrode kinetics, electrochemical equilibria and electroanalyses* which was presided over by Prof. Budevski, Institute of Physical Chemistry of the Bulgarian Academy of Sciences.

Session 6 on *Corrosion* had 33 papers, of which 12 were from the institute. In the discussion on microbiological corrosion it was pointed out that the sulphate reducing bacteria can reduce sulphates to hydrogen sulphide and the hydrogen sulphide can be oxidized by air to form a fuel cell with the simultaneous recovery of sulphur from naturally occurring sulphates. It was also pointed out that zinc and magnesium can act as anode and a fuel cell can be formed with sulphates and sulphate reducing bacteria. Discussion on metallic corrosion involved in methanol-hydrochloric acid fuel cells brought out the fact that a fuel cell containing methanol dissolved in sodium or preferably in potassium hydroxide had attractive commercial possibilities and very common constructional materials could be utilized. The last session was on *Solid state electrochemistry and instrumentation* in which nine papers were read, six from the Central Scientific Instruments Organization, Chandigarh and the rest from the institute.

Culture of Essential Oil and Medicinal Plants

Get-together at Jorhat

A get-together on production and utilization of essential oil-bearing and medicinal plants was held at the Regional Research Laboratory, Jorhat on 23 Jan. 1970. The get-together was inaugurated by Prof. V. K. R. V. Rao, Union Minister for Education & Youth Services and Vice-President, CSIR. It was organized with a view to bringing together the prospective producers of medicinal and aromatic chemicals in Assam and the industrial users of these chemicals located in metropolitan cities like Bombay and Calcutta. It focussed attention on the potentialities of plant culture and establishment of the industry in Assam and was attended by some forty delegates.

In his inaugural address Prof. Rao pointed out that there was a good case for the culture of citronella and other medicinal and essential oil-bearing plants and expressed the hope that the tea industry which had done such pioneering work in Assam would also pioneer the essential oil and medicinal plant cultivation in the state. Prof. Rao made a reference to the work of the laboratory aimed at efficient utilization of the waste products of the region. He urged the Assam tea industry to make full use of the facilities offered and the expertise available in the regional laboratory in Jorhat.

Four papers were presented and discussed at the technical session.

The laboratory contributed three papers on citronella, Japanese mint and Basil cultivation.

The first paper on citronella discussed in detail the laboratory's work on culture and processing of citronella. The cost of cultivation per acre and processing was about Rs 1000 per year as against the gross return of Rs 2000 to 3500 for the same period making possible a margin of Rs 1000 to 2500 per acre. The processing of the oil and the capital cost involved in the processing were also discussed. A plant capable of handling one tonne of raw material per day could be fabricated at the cost of about Rs 40 000. The demand for the oil was 400 tons. Through extensive cultivation of the grass, foreign exchange to the tune of Rs 20 lakhs could be saved.

The next paper detailed the laboratory's work on the cultivation and processing of Japanese mint, the

commercial source of menthol. It was indicated that the annual requirement of 100 tons of menthol could be indigenously met. The present import of peppermint oil is 160 tons valued at over Rs 68 lakhs. The cost data for cultivation and processing were discussed and a net return of Rs 1500 to 2000 per acre was estimated.

The third paper from the laboratory on *Oscimum* detailed the laboratory's work on the cultivation, processing and chemistry of the herb. The export potential of the oil was emphasized. At the present London market price of 200 sh/kg, the profit per acre works out to Rs 2000.

The delegates were assured of the laboratory's assistance not only with regard to the culture of these essential oil and medicinal plants but also design data and other technical help needed in processing.

Considerable progress has been made in the project dealing with the production of steroid hormones from *Solanum khasianum* berries. Based on the data obtained from the extraction unit to treat 100 kg/batch of berries, design details of a plant of capacity 1 ton/day have been obtained.

Of the other research and development projects which have made considerable headway during the year mention may be made of processes developed for the manufacture of (i) silica gel from clays containing high percentage of silica, (ii) aluminium sulphate from clay, (iii) pulp-cement roofing sheet from cotton linters, cottonseed husk and certain varieties of bamboo; and (iv) artificial nodulized soil-cement aggregate.

The laboratory continued its studies on the cultivation and improvement of medicinal and aromatic plants such as ergot, *Cymbopogon winterianus* Jowitt (Java citronella), *Solanum khasianum*, *S. laciniatum* and *Dioscorea* spp.

As many as 11 processes or products developed by the laboratory were ready for commercial utilization. These included : production of cinnamon oil from cinnamon leaves; cultivation of citronella grass and process for the recovery of citronella oil; microcrystalline wax; microcrystalline cellulose; rayon grade pulp; reclamation of old papers through deinking; lamination of boards; nodulized aggregates; reclamation of used lubricating oil; silica gel; vertical shaft kiln for cement manufacture; and nonheat treatment process for the production of iron ore pellets.

The 74-page report (demy 4to) also lists the patents filed (7) and accepted (2) and the research papers published.

PROGRESS REPORTS

RRL, Jorhat Annual Report 1967-68

The annual report of the Regional Research Laboratory (RRL), Jorhat for 1967-68, just published, reveals that the laboratory has made considerable progress in the projects dealing with paper, cellulose and hardboard. Processes for the production of grease-proof paper from bamboo pulp, microcrystalline cellulose from bamboo and wood pulp, dissolving grade pulp from bamboo involving pulping with nitric acid are some of the laboratory's contributions in the field. The process developed earlier for the production of hardboard and particle board from agro-industrial wastes with binder has been extended to the utilization of wild grass and weed for hardboard production. The boards were found suitable for use in building construction and furniture making. Another development in this field has been the utilization of paddy husk for hardboard production involving a pretreatment of husk to improve the quality of boards. A new process for producing laminated products for use in furniture, interior decorations, electrical insulations, machine parts, etc. using indigenously available raw materials has been developed.

Utilization of sucker rod wax and wax scrappings to produce high melting microcrystalline waxes has been a significant achievement in the projects dealing with petroleum. The microcrystalline waxes (55-95°C) can replace Carnauba wax which is presently imported. The laboratory has also developed a process for manufacturing lubricating greases by blending high melting microcrystalline waxes with mineral oils and fully refined petroleum waxes.

During the period under review the laboratory developed an improved process for the extraction of caffeine from tea waste giving higher yield and with greater adaptability for continuous operation than the liquid-liquid extraction process developed earlier.

Process details for the isolation of eugenol from cinnamon leaf oil by extraction with alkali followed by acidification have been worked out. Isomerization of eugenol to isoeugenol by heating with alkali under pressure has also been tried. This method gave a good yield of isoeugenol. The conversion of isoeugenol to vanillin is under investigation.

The progress of research and development work of the institute under twelve projects is dealt with in the 1968 annual report of the Central Drug Research Institute (CDRI), Lucknow just published. Each project report contains its aims and objects and summarizes the progress during the year.

The mechanism of action of the intrauterine contraceptive device

(IUCD) has been under investigation. Its continued use for 1 to 3 years was observed to cause marked accumulation of metabolically inactive proteins and of non-protein nitrogenous materials in the uterine fluid without a proportionate increase in related enzyme activity. These changes tend to disturb osmotic tension and consistency of the fluid in addition to rendering the milieu metabolically inert for growth and survival of the pre-implantation blastocyst. Administration of 17- α -hydroxyprogesterone caproate at the time of insertion of IUCD was found to prevent post-insertion bleeding in rhesus monkeys.

Investigations on the effect of estrogen and progesterone on the cervix and uterus of ovariectomized rats indicate that the cervix is predominantly under estrogen influence. The difference in sensitivity of these tissues to the ovarian hormones may play an important role in determining the synergistic or antagonistic relationship of the two hormones with respect to different indices in the tissues.

Preliminary studies have shown that some steroidal and non-steroidal compounds with known oral antifertility activity have the same effect when applied topically on the skin of experimental animals.

Chemotherapeutic, biochemical and immunological aspects of filarial, helminthic, protozoal and viral infections continued to be studied for obtaining leads for the design of new drugs.

A new technique for screening of antitubercular drugs in hamsters has reduced the assay period to two weeks.

Over 400 new compounds were synthesized and screened and 14 compounds showed activity in the primary pharmacological screen. In the other tests, one compound showed significant post-coital antifertility activity in rats, another two compounds showed blood sugar lowering effect, while one compound had antiviral action. In follow-up studies of compounds found active earlier, a potential anti-depressant was found to resemble imipramine in its activity profile but with a higher safety index. A local anaesthetic agent had activity comparable to lignocaine. An anti-pyretic, an anti-inflammatory com-

pound and a respiratory stimulant did not reveal any untoward effect in pharmacological and sub-acute toxicity studies.

Of 235 plants screened, 13 showed pharmacological activity. *In vivo* anti-cancer activity was confirmed in 13 plants, bringing the total of such plants to 32. Five compounds with antibacterial activity were isolated from *Arnebia nobilis*; these are derivatives of the anthraquinone alkanin. *Quercus lanceaefolia* showed good blood sugar lowering activity in rats. The hypotensive principle of *Croton sparsiflorus* was found to be the alkaloid N-methyl-crotosparine. The structures of the alkaloidal glycoside, alangiside, from *Alangium lamarckii* and of the alkaloid, koenigine from *Murraya koenigii*, have been elucidated.

Infection of spheroplasts of actinomycetes with vaccinia virus appears to induce genetic changes in the host which affect its ability to produce antibiotics.

Processes for the production of amphetamine, methamphetamine and psoralen were handed over to industry during the year for commercial utilization. Processes for adrenochrome, *p*-aminophenol and the sympathomimetic amines, adrenaline, non-adrenaline and isoproterenol have been standardized. Methods for procaine, ephedrine, phenylephrine, choline chloride, novaldiamine and *p*-phenylenediamine are in different stages of development.

A modified echinomycin has been obtained in which a quinoxaline carboxylic acid moiety is replaced by quinazolone, by microbiological synthesis using quinazolone as a precursor.

A scheme for studying teratogenic and carcinogenic activity of a proprietary preparation has been sponsored by the industry, while studies on acute and chronic toxicity of argemone oil and sanguinarine have been undertaken at the instance of the Indian Council of Medical Research.

One hundred research and review papers were published and four patents filed during the year under review. The patent (105190) in respect of the process for recovering anhydrous lanolin of B.P. and U.S.P. quality from crude wool fat was accepted.

Conversion of Coal to Oil and Gas : Special Lectures at CFRI

A series of four lectures on the developments in the technology of conversion of coal to oil and gas in USA was delivered by Dr G. R. Hill, Dean, College of Mines and Mineral Industries, University of Utah, USA at the Central Fuel Research Institute (CFRI), Dhanbad during 4-9 Dec. 1969. The lectures covered the coal research programme of the University of Utah—Project Western Coal, and various aspects of coal conversion such as dissolution kinetics, pyrolysis kinetics and processing of coal liquids for fuels and chemicals.

Speaking about the distribution and quality of fossil and non-fossil fuels in USA, Dr Hill described how coal, which lost its pride of place in the energy horizon and chemical industry in USA, was staging a comeback and a real coal rush was on. This remarkable resurgence has been made possible by the development of newer technology for the production of power, gas, oil and chemicals from coal at comparatively low cost. In the context of the dwindling reserves of natural gas, production of cheap pipeline gas from coal has also attracted considerable attention. Natural gas which was being used for domestic purposes is likely to be replaced by high btu pipeline gas produced from coal by the application of newer processes of complete gasification where the use of oxygen, the major cost-incurring factor, has been avoided.

Tracing the history of the development of synthetic oil production in USA, Dr Hill mentioned about the low and high temperature heating of oil shales and the conversion of the kerogen into oil. A major breakthrough was attained when shale oil kerogen was converted to oil *in situ* by means of hot natural gas as the heat-exchange medium. The next development in this field was simultaneous injection of hot natural gas through one pipe and low temperature vehicle oil through another into a bed of oil shale *in situ*. From these studies Dr Hill concluded that in the case of coal conversion it would be advantageous to break coal at low temperatures under reducing conditions.

For conversion of coal to liquid products research effort is concentrated at present on solvent extraction, hydrogenation, and pyrolysis techniques. The hydrogenation route is mainly designed for oil production. Hydrogenation was found to be the most promising process of coal liquefaction for adaptation on a large scale. The hydrogenation process gave good yields of liquid and gaseous products and the crude oil was of good quality.

Presenting actual experimental data on the catalytic hydrogenation

of Assam coal and two Utah coals in batch as well as semi-continuous unit, he stated that higher yields of liquid and gaseous products were obtained in the semi-continuous experiments. A reaction temperature of 515°C, hydrogen pressure of 2 000 psi and a catalyst concentration of 15% by weight of coal were found to be optimum.

Dr Hill expressed the view that a programme of coal hydrogenation would be an advantageous proposition for India.

has been suggested that the phase relation between the light flashes and the sound waves as well as the spectral composition of the luminescence favour the hot spot theory based on the generation of high temperatures following adiabatic compression of the cavitation bubbles. The other findings such as the action of reducing agents and production of free radicals have been interpreted to support strongly the chemi-luminescence theory which attributes the emission of light to the recombination of free radicals. It is thus inferred that both the mechanisms simultaneously contribute to the emission of light but the effect of one may predominate.

Mr Sidkey, who worked under the guidance of Dr M. Pancholy, Acoustics Division, NPL, was awarded the Ph.D. degree by the Cairo University, UAR.

Sonoluminescence in Liquids

UAR Scientist's Work at NPL : Doctorate Award by Cairo University

The nature and origin of the phenomenon of sonoluminescence—the emission of faint light from engassed liquids cavitated by intense sound fields—has been studied by many workers. But there is no agreement both on the experimental results and the conclusions drawn as to the origin of the phenomenon. Several theories have been suggested to account for the origin of sonoluminescence. A study of these theories shows that they are closely connected with the mechanism of cavitation process but make different assumptions and envisage different mechanisms for the phenomenon.

Comprehensive investigations on the role of ultrasonic intensity, temperature and of chemical impurities in sonoluminescent intensity has been carried out by Mr M. A. Sidkey of the National Research Centre, Cairo, who worked under an exchange programme at the National Physical Laboratory, New Delhi. The investigations also covered sonoluminescence emitted by a number of liquids, spectral distribution of the emitted light and phase relation between emitted light flashes and the exciting sound waves.

Most of the work has been carried out at 450 kHz using a bowl transducer capable of producing high ultrasonic intensities in the focal region and a photomultiplier tube for the quantitative estimation of the emitted light. An analysis of the results shows that the sonoluminescence intensity increases with increase

in acoustic power and the relation between the ultrasonic intensity and the sonoluminescence intensity is substantially linear.

The intensity of sonoluminescence is found to increase with increase in temperature from 5° to 25°C and above this temperature the sonoluminescence intensity starts decreasing. It depends on both the nature of the dissolved salts and the concentration of the salts added. With sodium bicarbonate and sodium phosphate, the intensity decreases with increase in concentration, whereas with sodium chloride and sodium hydroxide, the intensity increases with increase in concentration. Sonoluminescence flashes appear near the sound pressure maxima but do not take place with every sound cycle.

The study has provided useful data on relative sonoluminescence intensities in a number of pure liquids, change in intensity brought about by traces of water, effect of dissolved salts and their concentration, effect of temperature variations, relation between sonoluminescence intensity and exciting ultrasonic power and the formation of H_2O_2 due to ultrasonic irradiation.

The results support a correlation between the sonoluminescence intensity and certain physical properties of the medium as the intensity of the emitted light is found to vary directly as the square of surface tension of the liquid and inversely as its vapour pressure. It

CPHERI's Technical Digest

Effective January 1970 the Central Public Health Engineering Research Institute (CPHERI), Nagpur has started publishing 'Technical Digest', a mimeographed monthly release. Each of the digests will carry brief notes on some aspects of public health engineering research work in India. The first number deals with defluoridation and reports the development of 'Defluoron-2', a new medium for reduction of fluorides in water supplies. It has satisfactorily stood pilot plant tests in the field. Defluoron-2 is a synthetic carbonaceous sulphonated material in granular form with bulk density 810 kg/cu m. Its fluoride removal capacity is 620 mg of fluoride/kg of medium (224 grains/cu ft). It can be used in an installation similar to a pressure-type filter. The bed depth of medium is kept 0.91 m and the maximum operating surface flow rate is restricted to 8.6 cu m/sq m of bed area per hour. The cost of the medium is about Rs 1500 per cu metre; the running cost, Re 1 to Rs 2 per 1000 gallons depending on the fluoride concentration in the untreated water. A home defluoridator suitable for family use has also been developed by the institute.

Copies of 'Technical Digest' are available gratis from the Director, CPHERI, Nagpur on request.

New Schemes

Complex Carbonates of Transition Metals and Rare Earths

In recent past some work has been done on the complex carbonates of cobalt (III), thorium and uranium (VI). Many complex carbonates of transition metals and rare earths have also been studied. This work which has thrown light on the co-ordination capacity of the carbonate group as well as the analytical chemistry of these elements calls for reinvestigation through modern experimental and theoretical approach for a thorough understanding of the chemistry of these compounds. A new CSIR scheme entitled 'Complex carbonates of transition metals and rare earths' under the purview of the Chemical Research Committee has been sanctioned at the Department of Chemistry, Kalyani University. The principal investigator in the project is Dr A. Sengupta, Reader in Inorganic Chemistry. Studies will be made on the preparation and analytical application of some known complex carbonates and of several unknown complex carbonates. The stability of these carbonates in solution and in solid state at different temperatures will be studied by physico-chemical methods including thermometric and X-ray methods.

Completed Schemes

Mossbauer Studies of Some Iron Compounds

Studies on the Mossbauer effect of alkali metal ferricyanides and ferrocyanides, and alkali metal and transition metal nitroprussides have been made by Shri A. N. Garg, CSIR junior research fellow, working at the Department of Chemistry, Indian Institute of Technology, Kanpur. The study was made under the guidance of Dr P. S. Goel, Associate Professor of the Department and lasted from 1 Aug. 1967 to 30 April 1969.

Anhydrous ferrocyanic acid, $H_4Fe(CN)_6$, and lithium ferrocyanide, $Li_4[Fe(CN)_6] \cdot 3H_2O$, have been synthesized and their Mossbauer spectra studied at room temperature

and liquid helium temperature. A definite quadrupole splitting (ΔE_Q) was observed for $H_4Fe(CN)_6$ at 292 and 80°K. It is attributed to the presence of hydrogen bonding between the cyanide ligands in confirmation with earlier infrared, X-ray crystallographic and refractometric studies. The isomer shift (δ) decreases with increase in electronegativity indicating a corresponding decrease in 3d-electron density around the iron nucleus.

The Mossbauer spectra of anhydrous ferricyanic acid, $H_3Fe(CN)_6$, and alkali metal ferricyanides, $M_3[Fe(CN)_6] \cdot xH_2O$ (where $M=Li, Na, K, Rb, Cs, NH_4$ and Ag), have been studied at room temperature. These compounds show a two-line spectrum indicating definite quadrupole splitting (ΔE_Q). values of ΔE_Q range from 0.20 to 0.76 mm/sec. The isomer shifts (δ) vary from 0.08 to 0.26 mm/sec. (relative to sodium nitroprusside dihydrate). The isomer shift shows generally a decreasing trend with the increase in the electro-negativity of the substituent cation. The s-electron density at the iron nucleus increases as the π -acceptor nature of the ligand increases. The quadrupole splitting data are also consistent with this interpretation. A linear relationship has been observed between δ and ΔE_Q and it is suggested that the electric field gradient at the iron nucleus in these compounds is negative. The isomer shift for $H_3Fe(CN)_6$ is somewhat high and is explained as due to the presence of intermolecular hydrogen bonding in this compound.

Research papers

Garg, A. N. & Goel, P. S., Mossbauer effect evidence of hydrogen bonding in ferrocyanic acid, *J. inorg.nucl. Chem.*, **31** (1969), 697-702.

International Hydrological Decade

Dr K. R. Ramanathan, Chairman, Atmospheric Sciences & Scientific Hydrology Research Committee of CSIR, and Chairman, National Committee for International Hydrological Decade (IHD) led the Government of India delegation to the inter-governmental conference

of the International Hydrological Decade and of International Cooperation in Hydrology held in Paris during 8-16 Dec. 1969. The conference was attended by representatives of 71 countries and UN agencies.

The conference discussed the outcome of the IHD projects during the first five years (1965-69) of the Decade programme launched by Unesco and made recommendations through 26 resolutions as guidelines for future work. The main points are: (1) emphasis on the establishment of adequate hydrometric network and systematic collection of hydrologic data with particular reference to assessment of sub-continental, regional and world water balance; (2) instrumentation for setting up of the Decade stations and basins and provisions of instruments/equipment for developing countries by Unesco; (3) exchange of information and preparation of manuals and guide books for assessment of water in the land phases of the hydrologic cycle; and (4) hydrologic education and training.

The conference urged the member-states to maintain and improve their National Hydrological Committees for implementing collaboration and hydrological investigation at different levels and to plan machinery for cooperation in a long-term hydrological programme. The National Committee secretariat in CSIR is responsible for the implementation of this international programme.

Symposium on Satellite Meteorology

A symposium on *Satellite Meteorology* is being organized jointly by the CSIR and the India Meteorological Department at Poona from 10-13 April 1970. CSIR has made a small provision to defray the travelling expenses of a few scientists in universities and non-service organizations, who may wish to present papers and/or participate in the symposium but who may have difficulty in getting the necessary funds for travel and incidental expenses. Those who wish to get financial assistance may apply with particulars including title of paper and minimum financial assistance required. The application should be sent through the head of

the institution to Dr C. Ramaswamy, Member-Secretary, CSIR Research Committee on Atmospheric Sciences & Scientific Hydrology, C/o The Observatory, Lodi Road, New Delhi-3 before 24 March 1970.

Dr H. V. K. Udupa

Dr Handady Venkata Krishna Udupa took charge as Director, Central Electrochemical Research Institute (CECRI), Karaikudi on 16 Jan. 1970.



Born in 1921 at Handady, South Kanara, Shri Udupa graduated in chemistry from St Aloysius' College, Mangalore. He took B.Sc. (Hons) in chemistry with electrochemistry as special sub-

ject in 1944 and M.A. degree from the University of Madras in 1945. He obtained his M.Sc. in chemistry from the Presidency College, Madras in 1947 by research; his postgraduate thesis was titled 'Preparation of dye intermediates by chemical and electrochemical methods'. He took his A.M. degree in industrial chemistry (with specialization in electrochemistry) from the Columbia University in 1948, followed by the Ph.D. degree of the Ohio State University for his thesis: 'Electrolytic reduction of some nitro and carbonyl compounds' in 1950.

Dr Udupa worked as research assistant in the Presidency College, Madras on a CSIR sponsored scheme: 'Electrolytic reduction of nitro compounds leading to the manufacture of direct cotton colours' from Sept. 1944 to June 1947. He was at the Ahmedabad Textile Industry's Research Association, Ahmedabad during 1951-53.

Dr Udupa joined the Central Electrochemical Research Institute, Karaikudi as Senior Scientific Officer in July 1953. He took over as Scientist-in-charge of the institute in August 1967. Dr Udupa has been engaged in research in the fields of electrodeposition of single metals and alloys, electro-organic oxidations and reductions, electro-inorganic

products, batteries and metal powder preparation by electrolysis.

Some of Dr Udupa's contributions to the advancement of electrochemistry and electrochemical technology include: (1) the use of the rotating electrode technique in electro-organic reductions and oxidations enabling ease of design of high capacity cells using high current densities; (2) development of insoluble anodes, viz. graphite substrate lead dioxide for a number of electro-inorganic oxidation reactions (substituting platinum anodes for production of perchlorates on an industrial scale); (3) controlled oxidation of organic compounds using electrolytically regenerated inorganic reagents; and (4) direct electrochemical reduction of metal oxides and hydroxides to the corresponding metal powder. Several processes have been developed based on these improved production techniques which have become subjects of a number of patents.

Dr Udupa has published over 130 papers in electrochemistry, organic chemistry and textile chemistry. He has over 44 patents to his credit. Twelve processes with which he is associated have been released to industry and another 13 processes are ready for commercial utilization. Two of his inventions have won awards from the Inventions Promotion Board.

Dr Udupa is an Associate of the Royal Institute of Chemistry, London and Fellow of the Institution of Chemists (India). He is a member of Phi Lambda Upsilon, the National Chemical Society of USA, Electrochemical Society of USA, Comite International de Thermodynamique et de Cinetique Electrochimiques, Indian Science Congress Association and the Society for the Advancement of Electrochemical Science and Technology.

Dr Udupa is associated with a number of committees of the Indian Standards Institution, and Research Designs & Standards Organization, Ministry of Railways. He is also member of Advisory Board of the proposed International Journal of Applied Electrochemistry to be published by Chapman & Hall, London.

PATENTS FILED

123845: An improved process for the preparation of alkyl nitrate esters from aliphatic alcohols (for cognating with third divisional of 120116), P. Desikan & K. K. Bhattacharyya—IIP, Dehra Dun.

123998: Process for preparation of alkyl nitrate esters for use as cetane improver additive: an improved process for the preparation of alkyl nitrate esters from glycol ethers (divided out of patent application No. 120116: I divisional), P. Desikan & K. K. Bhattacharyya—IIP, Dehra Dun.

123999: Process for preparation of alkyl nitrate esters for use as cetane improver additive: an improved process for the preparation of alkyl nitrate esters from alicyclic alcohols (divided out of patent application No. 120116: II divisional), P. Desikan & K. K. Bhattacharyya—IIP, Dehra Dun.

124000: Process for preparation of alkyl nitrate esters for use as cetane improver additive: an improved process for the preparation of alkyl nitrate esters from aliphatic alcohols (divided out of patent application No. 120116: III divisional), P. Desikan & K. K. Bhattacharyya—IIP, Dehra Dun.

SEALED

101929: Improvements in or relating to single shot batteries of the reserve type, M.A.V. Devanathan, B. A. Shenoi, P. L. Joseph & V. Balasubramanian—CECRI, Karaikudi.

102482: Improvements in or relating to electrolytic preparation of potassium perchlorate, H. V. K. Udupa, S. Sampath, R. Viswanathan & M. Nagalingam—CECRI, Karaikudi.

103970: Improvements in or relating to direct plating of copper on aluminium, B. A. Shenoi, R. Subramanian & S. Seetharaman—CECRI, Karaikudi.

104196: Process for the production of tristearin like materials from castor oil, G. L. Reddy & J. S. Aggarwal—RRL, Hyderabad.

105190: A process for the recovery of anhydrous lanolin of B. P. and U. S. P. quality from crude wool fat, N. K. Garg & C. R. Krishna Murthy—CDRI, Lucknow.

105491: A process for the manufacture of a plasticizer for resins like polyvinyl chloride resins (PVC), R. K. Bhatnagar & S. Singh—SRIFIR, Delhi.